# Innovative Electronics Cooling Technology Offers Increased Flexibility and Reduced Costs

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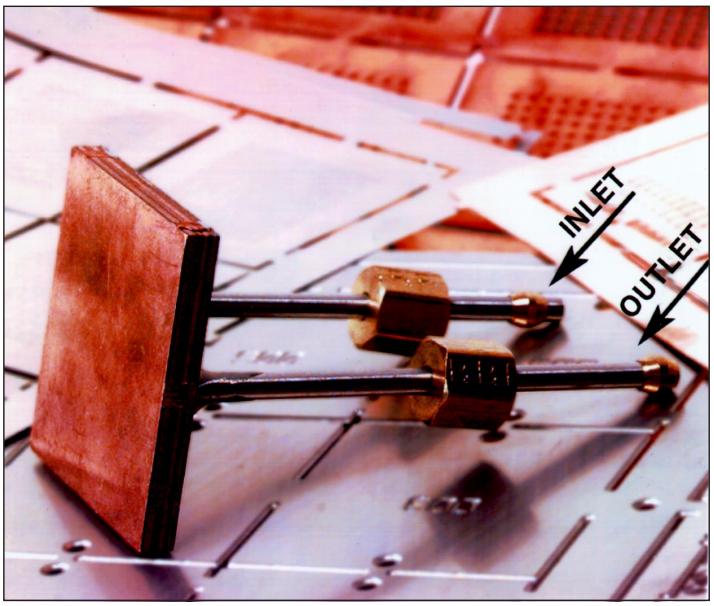


## Payoff

The miniature electronics cooler shown above will have the capacity to cool high power electronics, such as those being developed for DoD's More Electric Initiative. These electronics can generate waste heat fluxes on the order of hundreds of watts/square centimeter ($W/cm^2$) vis-a-vis Intel's Pentium processor, which generates about 20 $W/cm^2$. Common fluids such as air, water, JP fuel or polyalphaolefin can be used with minor modification of the cooler design, enabling increased flexibility and reduced logistics costs.

## Accomplishment

Under a Small Business Innovation Research (SBIR) program, sponsored by the Propulsion Directorate's Power Division, Makel Engineering Inc. of Sacramento CA developed an innovative electronics cooling technology based on heat exchange technology originally developed for the National Aero-space Plane Joint Program Office. Cooling heat fluxes as high as 300 $W/cm^2$ (using polyalphaolefin (PAO)—an onboard aircraft coolant, and water) were demonstrated with thermal resistances much less than 0.2° $C/W/cm^2$ over an area of 6.5 $cm^2$. These levels were achieved without using phase change processes or exotic fluids.

## Background

The DoD is developing electronics capable of controlling hundreds of kilowatts of power for More Electric Initiative applications. The employment of systems utilizing these electronics will allow aircraft to function more efficiently without the presence of conventional mechanical/hydraulic systems, thus yielding a 20% maintenance cost savings to the Air Force. Even with power device efficiencies of 99%, the high power throughput of these devices yields waste heat fluxes on the order of hundreds of $W/cm^2$. Thus, the cooling of electronics becomes a much more formidable task, although the overall heat load on the aircraft is much reduced. Further compounding the cooling problem is the restriction that existing on-board coolants must be used. The addition of a new coolant to the Air Force inventory would have severe logistics cost implications, however, existing coolants, PAO, JP fuels and air are all relatively poor performers. The development of a heat exchanger technology that can overcome the cooling limitations of these fluids is essential for the success of the More Electric Initiative.